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ABSTRACT

The instructional design possibilities of a computer-assisted learning environment that would provide feedback to students in an introductory statistics class were studied. Cognitive styles that were thought to relate to mathematical or statistical processes were tested, including field independence and field dependence, locus of control, and holism and serialism. Participants were 102 graduate education students who were assigned to text-only, text and static graphic, and text and animated graphic presentation modes. The computer presentation included a pretest of statistical knowledge, the presentation of content information, and questions designed to determine the cognitive styles. Results suggest that text-only presentation was significantly different for students with various levels of field independence. No significant differences for presentation method were found based on locus of control and holism/serialism. There was gain in knowledge for all three modes of presentation, although sample sizes were very small. (Contains 24 references.) (SLD)

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Incorporating Individual Learning Styles into Computer Assisted Environments for Instruction Basic Research and Statistical Concepts.

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Introduction

Many non-mathematics majors find the task of taking an introductory statistics course something to avoid as long as possible (Potter, 1995; Schacht and Stewart, 1992; Bessant, 1992). Some of these students are lacking a solid background in mathematics and need to spend more time developing knowledge in the basic concepts. The purpose of this study was to explore the instructional design possibilities of a computer-assisted learning environment which would assist and provide feedback to students needing this extra practice. To provide effective feedback it was felt that adjusting for individual differences should be made part of the instructional design.

Cognitive styles which were thought to relate to mathematical or statistical processes were tested in conjuncture with the knowledge to investigate their future use in designing feedback addressing the user's individual differences. These cognitive styles include: Field Independence and Field Dependence (FI/FD), Locus of Control (LOC) and Holists and Serialists (H/S). This computer-assisted-environment (CAE) would explore the possibility of using cognitive styles that would enable the program to suggest alternatives to best fit the individual when receiving instruction.

In previous computer-assisted designs, a lack of a theoretical base was criticized by some researchers (Clark, 1985; Reeves, 1993). This study attempted to use a Brunswik dual lens as a theoretical bases for the creation of a CAE. Brunswik suggested that individuals perceives the instruction with an individualistic modality which may include all or none of the original intent of the instructor. The more information ("cues") which are presented, the more knowledge becomes representative of the instruction. The research begun by Brunswik should encourage educators to consider the "value of ideographic analysis of teaching and learning in terms of observed behavioral cues and inferred personal traits" (p.1) when designing and/or delivering instruction (Snow, 1968)

Khoury and Behr (1982) defined field-independence (FI) as a predisposition to observe the "environment analytically or in a differentiated fashion" (p.4) and field-dependence (FD) as a predisposition to observe the "environment in a global and undifferentiated fashion" (p.4). Field-independence students seem to restructure concepts presented to them, thus, enabling a deeper encoding of the concepts when compared to passive FD students (Carrier,

Davidson, Higson, & Williams, 1984). The restructuring of information requires both attention and activity which increases encoding into long term memory (Ashcraft, 1989, p.57). Presentation types made a difference for FD/FI students in a study done by Wey and Waugh (1993). When using the text/graphic mode, there was no significant difference comparing the result (simple fact-based questions on topics from a course in Western Civilization) obtained by independent or dependent participants. However, when the medium was text only the FI students fared better. The graphic helped the FD learner to isolate the important issues from the background.

Locus of control and college instruction were investigated in several studies (Daniels and Stevens, 1976; Holloway, 1978; Ryback and Sanders, 1980). They found that internally oriented students preferred student center instruction and external oriented students preferred teacher-centered instruction. Ford (1985) looked at a Holists/Serialists learning strategies when looking at complex subjects. Holists use a broad approach building and filling in gaps with each new detail of information. Serialists on the other hand approach complex subjects by focusing on narrow pieces of information and build up their understanding step by step.

Computer uses in Instruction/Remediation

At the center of debate of the value of computerized instruction is whether or not it influences the learner. When compared to the lecture hall, CAE has the capability of delivering individualized lessons "rather than being restricted to normative characteristics of a class of students" (Ross, 1984, p.42). The continuing challenge for educators is the capacity of adjusting for individualistic characteristics (Bovy, 1981). Multimedia presentation can present instructional material in a variety of methods with the added flexibility of mobility from the computer lab to the home.

A total of 102 graduate students (53 females, 49 males) enrolled in various graduate education classes at Virginia Tech volunteered to participate in the study. Each participant was systematically assigned to one of three treatment groups with an expected sample population in each treatment of thirty-four individuals. The instructional material and evaluative instruments were delivered using Authorware 2.0 (Macomedia, Inc.) as the software development application. Seven instruments were used in the study: (1) a

demographic instrument,(2) Rotter's Locus of Control scale, (3) Hidden Pattern Test (ETS), (4) Holists/Serialists test (Ford, 1985), (5) Pre-test, (6) immediate recall test, and (7) delayed recall test.

The computer-assisted learning environment was created using a multimedia presentation program to deliver a text-only , text and static graphic, and text and animated graphic modes. The computer program was started when participants entered a randomly assigned four digit code. The program presented the following segments: demographic survey, pre-test of statistical knowledge, two sections of the hidden patterns test, five question holists/serialists scale, the presentation of information about sampling, locus of control questionnaire, a post-test of sampling knowledge and a questionnaire about the participant's experience. All the responses to the computer program's questionnaires and measures were recorded on a floppy disk. A paper and pencil recall test was given one week after the computer presentation. Participant identification for the paper and pencil test was accomplished by using the same four digit number assigned earlier.

The analysis was performed using an ATI technique (Cronbach & Snow, 1969) The results suggested that the text-only presentation module was significantly different for these students with various levels of FI. No significance was found with either of the other two cognitive measures. Neither LOC or H/S cognitive measures demonstrated any significance for the presentation method. This result was different from an earlier pilot study (Packard, Holmes, and Fortune, 1995) of undergraduates where levels of LOC seem suggest the most appropriate delivery methods. Following the Brunswik model where students are allowed freedom of choice as how they investigate the information being presented. some of the differences between internal/external individual may become more apparent. During this study, no choice were allowed as to CAE presentation method or what information sources to visit. Also the question of relevance of the information material will also point out value, as individuals with internal locus of control are more apt to see the link between what they do and how it will affect their academic performance (Bhagat and Chassie, 1978). Little research has been done at the collegiate level with LOC and CAE leaving the value of this measure uncertain.

The twelve qualitative questions offer insight into learner's motivation for using the delivery methods. Results from these questions would suggest that the program was enjoyable to use and would be used if it were available. More individuals suggested that they would prefer presentation methods which include graphics. However, results pointed toward the text only presentation as enabling more learners to perform better on the recall scores. This observation is supported by several researchers studying learner control (Burwell, 1991; Carrier, 1984). In the current study, the one significant finding pertained to question 10 which addressed learner choice. Ninety-five percent of the respondents believed that they could choose the appropriate instructional delivery rather than having the machine choose for them (sixty-four percent). This feeling would support the findings of a study by Schwier (1993) suggesting that individuals experience more ownership in the educational process when allowed to make decisions about the method of delivery for their own instruction.

The purpose of this study was not to test the differences between CAI presentation methods but was aimed at examining possible interactions between cognitive traits and instructional methods. Although there are few statistical results supporting the original hypotheses suggested that there would be differences between knowledge gained and method of presentation, interactions were present. A larger population needs to be studied as in many cases significant findings are negated because of a small sample size. Efforts should be made to include a more homogeneous sample along such dimensions as statistical experience, levels of post-secondary education and computer experience. A control group receiving no instruction could be used to confirm instructional delivery was effective.

The duration of knowledge instruction during this study was brief and therefore not conducive to long-term memory gain of the instructional material. Although not significant, there was gain in knowledge by the participants in all three modes of deliver. The capacity for this instructional medium to deliver instruction has been observed and answers to the twelve qualitative questions suggest that it aid the learner's motivation. The measure of locus of control appears to have some discriminatory ability with undergraduates as well as for older students. Although other studies (Baek and Layne, 1988; Osman and Hannafin, 1992) have suggested success with different methods of presentation, no real significant findings were present in this study. The investigation of small segments of the sample population showed differences the sample sizes for this sub-groups were too small.

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